

SYNOPSIS OF THE INTERAGENCY CRAB RESEARCH MEETING  
HELD IN ANCHORAGE DURING DECEMBER 15-16, 1994



By

Gordon H. Kruse

Regional Information Report No. 5J94-24  
Alaska Department of Fish & Game  
Commercial Fisheries Management and Development Division  
P.O. Box 25526  
Juneau, Alaska 99802-5526

December 30, 1994

SYNOPSIS OF THE INTERAGENCY CRAB RESEARCH MEETING  
HELD IN ANCHORAGE DURING DECEMBER 15-16, 1994

By

Gordon H. Kruse

Regional Information Report No. 5J94-24  
Alaska Department of Fish & Game  
Commercial Fisheries Management and Development Division  
P.O. Box 25526  
Juneau, Alaska 99802-5526

December 30, 1994

---

<sup>1</sup>The Regional Information Report Series was established in 1987 to provide an information access system for all unpublished divisional reports. These reports frequently serve diverse ad hoc informational purposes or archive basic uninterpreted data. To accommodate timely reporting of recently collected information, reports in this series undergo only limited internal review and may contain preliminary data; this information may be subsequently finalized and published in the formal literature. Consequently, these reports should not be cited without prior approval of the author or the Commercial Fisheries Management and Development Division.

## **PURPOSE**

This report briefly summarizes the interagency crab research meeting held during December 15-16, 1994 at the Observer Training Center in Anchorage. This was the second annual meeting of state and federal crab researchers. The first was held in Kodiak during August 24-25, 1993. The purposes of these meetings were: (1) to provide an opportunity for researchers and managers of Alaskan crab fisheries to discuss ongoing and future research projects; (2) to facilitate interagency cooperation and coordination of research; and (3) to develop long-term crab research goals and near-term priorities.

## **PARTICIPANTS**

This year's meeting was very well attended. Participants included individuals from the Alaska Department of Fish and Game (ADF&G), National Marine Fisheries Service (NMFS), University of Alaska Fairbanks (UAF), University of Washington (UW), and the North Pacific Fishery Management Council (NPFMC).

ADF&G staff in attendance were: Anchorage - Jeff Bromaghin, Todd Laflamme; Sue Merkouris; Cordova - Charlie Trowbridge; Douglas - Doug Woodby; Dutch Harbor - Donn Tracy; Homer - Bill Bechtol, Al Kimker; Juneau - Doug Eggers, Ken Griffin, Gordon Kruse (chair), Peggy Murphy, Jie Zheng; Kodiak - Forrest Blau, Suzie Byersdorfer, Bill Donaldson, Dave Jackson, Doug Pengilly, Pete Probasco, Al Spalinger, Dan Urban, Leslie Watson; Nome - Fred Bue, Charlie Lean; and Petersburg - Tim Koeneman. NMFS staff were: Kodiak - Bob Otto, Brad Stevens; Seattle - Rich Marasco, Russ Nelson, and Jerry Reeves. David Witherell represented the NPFMC (Anchorage). Attenders from UAF, School of Fisheries and Ocean Sciences were: Fairbanks - Al Tyler; and Juneau - Shijie Zhou. José (Lobo) Orensanz from the UW, School of Fisheries, also participated.

## **PRELIMINARIES**

The meeting was chaired by Gordon Kruse. After staff introductions, opening remarks were delivered by Rich Marasco and Doug Eggers. They spoke about the purpose of the meeting and a general desire to provide a forum for informal discussions on crab research by interagency staff. Rich briefly described the federal crab research initiative, now in it's second year of funding, which has served as the catalyst for these meetings.

Gordon Kruse provided a draft agenda in advance of the meeting. There were no recommended changes to the agenda, and the agenda was closely followed with minor exceptions. This report is organized to parallel the agenda. In overview, the first day included informal presentations by crab researchers on ongoing projects. The second day largely included discussions about research needs and priorities.

## ONGOING CRAB RESEARCH

### NMFS - Kodiak

Bob Otto distributed a handout titled "An outline of Current and Planned NMFS Crab Research." This document provided an informative overview of NMFS research interests including current investigations, short-term research plans, and long-term needs.

Bob discussed handling studies on Tanner crab (*Chionoecetes bairdi*). A study was conducted with a design similar to studies by Tom and Susan Shirley on Dungeness crab (*Cancer magister*) and Shijie Zhou and Tom Shirley on red king crab (*Paralithodes camtschaticus*). The experimental design included treatments in which Tanner crabs were dropped either one or four times from a height of 2.5 m into sea water. Mortality was monitored for 60 d. Preliminary results indicate that no significant differences existed among treatments and the control.

Bob described a second study in which crabs were subjected to injuries similar to those observed during fisheries. Treatments included *bend* - twist leg joint backwards, *pinch* - snip off leg tip, and *smash* - crack dorsal side of carapace with hammer. Smashed crabs experienced higher mortality than controls. Pinched and bent crabs did not experience elevated mortalities, but legs were autotomized.

Bob described some planned work that included an "elevator ride" experiment in which Tanner crabs will be subjected to repeated pot retrieval and deployment. Other studies include a catchability study with David Somerton and plans to increase the density of survey stations in Bristol Bay with cooperative industry funding. Bob briefly mentioned studies of spatial distribution being conducted by Alan Johnson of his staff.

Brad Stevens described his cooperative studies with ADF&G on reproductive behavior of Tanner crabs. He reviewed his National Undersea Research Program (NURP) submersible study of Tanner crab in Chiniak Bay. Interesting conclusions included the observation that hundreds of small mounds of females congregate in spring in Chiniak Bay. Observations indicated that only oldshell males with a large claws were involved in mating. Females sampled prior to mating in 1994 had virtually no stored sperm. This result is in contrast to José Orensanz's findings of significant stored sperm volumes in female *Chionoecetes* in the Bering Sea. It may be that male abundance is too low for mating with females in Chiniak Bay. Trawl samples indicate a female:male sex ratio of about 10:1 whereas submersible observations near mounds suggest a ratio of 100:1. An interesting spin-off of this project is the location of 187 lost crab pots in a section of Chiniak Bay by side-scan sonar. This lost gear may provide an excellent opportunity to begin investigating the effects of lost gear on crab populations. Unfortunately, a proposal for further study in 1995 was not funded by NURP. Reprints of a number of project publications are available from Brad Stevens.

### *University of Washington, School of Fisheries*

José (Lobo) Orensanz provided a handout titled "Snow and Tanner Crab Studies, Progress Report, December 9, 1994" that updated work conducted by himself, Dave Armstrong and Ahmad Nevissi of the University of Washington, School of Fisheries. Cooperating investigators include A.J. Paul and Bob Otto. Lobo briefly described their work on radiometric ageing of Tanner crab using ratios of  $^{228}\text{Th}/^{228}\text{Ra}$ . To use this method, samples need to be stored for 6-12 months. This project is also using ages of barnacles attached to crab exoskeletons as a second indicator of minimum shell age. Tanner crabs of known molting age are being maintained by A.J. Paul in the Seward Marine Science Center for validation of techniques.

Lobo described another area of research into the reproductive dynamics of female snow (*Chionoecetes opilio*) and Tanner crabs. Samples were collected from multiple locations in the Bering Sea during NMFS trawl surveys. Variables to be considered are shell condition, geographic location, size, egg volume, and density of males. Preliminary results indicate the possibility of biennial spawning in Bering Sea snow crabs.

### *NMFS - Seattle*

Jerry Reeves provided a handout titled "Assessment of Bering Sea/Aleutian Islands Crab Stocks." Jerry briefly talked about ongoing work with Russ Kappenman using the delta distribution to re-estimate historic red king crab abundances in Bristol Bay. This work indicates a tendency for the delta distribution to provide a lower estimate of abundance than that provided by direct area-swept methods.

Jerry also discussed the calculation of instantaneous fishing mortality rates for Bering Sea/Aleutian Islands crab stocks in 1993. The analysis included catch statistics from directed crab fisheries and bycatch in crab and groundfish fisheries. This analysis indicated that Adak red and golden (*Lithodes aequispinus*) king crabs may be overfished whereas Bristol Bay red king crab and Bering Sea Tanner crab are nearly overfished.

### *ADF&G - Headquarters (Juneau and Anchorage)*

Gordon Kruse provided a brief overview of state funding initiatives. He described an increment submitted for Bering Sea Stock Assessments. One component is a Capital Improvement Project (CIP) for pot and trawl gear for approximately \$250,000. The other component is a general fund increment for approximately \$750,000. This increment would pay for a re-survey of Bristol Bay with a high density of stations in late summer and a trawl survey of Norton Sound red king crabs. The increment would also pay for a pot survey for blue and red king crabs in the Pribilof Islands area.

This year's annual funding to ADF&G for crab research under cooperative agreement with NMFS is \$237,500. Gordon described the plan for expenditures. Past or current funded

projects include crab stock identification by genetics (Sue Merkouris), population estimation and analysis of harvest strategies (Jie Zheng, Peggy Murphy, and Gordon Kruse), nearshore crab studies (Forrest Blau), crab reproduction studies (A.J. Paul), crab handling studies (Shijie Zhou and Tom Shirley), and crab population dynamics (Al Tyler).

Gordon provided a number of handouts including: (1) "King and Tanner crab research in Alaska: Annual report for July 1, 1993 through June 30, 1994;" (2) "King and Tanner crab research in Alaska: Executive summary of work completed by the state of Alaska during 7/1/93-6/30/94 and work planned for 7/1/94-6/30/9;" (3) "King and Tanner crab research in Alaska: a long-term work plan;" (4) a reprint titled "Handling Increases Mortality of Softshell Dungeness Crab Returned to the Sea; and (5) "List of Recent ADF&G Crab Publications and How to Obtain Copies."

Sue Merkouris provided a handout titled "ADF&G Genetics Laboratory Shellfish Projects" that outlined crab genetic studies to date. She described her stock identification studies on Tanner and snow crabs using allozymes. Laboratory and data analyses are complete and a manuscript is being prepared. In general, average heterozygosities among samples are low and the overall genetic distances among populations are small.

Allozyme results prompted a pilot study using mitochondrial and nuclear DNA contracted to Paul Bentzen of UW. Two of four methods of DNA extraction worked well on *Chionoecetes* species. Preliminary results indicate that DNA is more promising for stock discrimination than allozymes.

Sue described a second study on Tanner and snow crabs and their hybrids. A manuscript is currently being prepared. In sum, Sue found fixed differences among parents. She is also able to identify first generation (F1) hybrids, and she has found good evidence for back-crossed individuals. This second finding implies that at least some hybrids are functionally mature and are able to produce viable offspring. Based on these results, Sue was able to determine the true identities of *Chionoecetes* sampled for a study of computer-based classification of snow, Tanner and hybrid crabs. Bill Donaldson reported on this latter study later in the meeting.

Sue reported on an ongoing stock identification study of red king crabs by Lisa Seeb. Three recent collections bring the database to 38 collections. Some analyses were completed, but screening for new markers continues. The allozyme results indicate stock structuring at the regional level. To determine the possibility of finer discrimination, a pilot DNA study was contracted to Paul Bentzen of UW. As with allozymes, red king crabs are a difficult species for DNA studies. Standard "universal primers" do not work well. Continuing work involves other primers and techniques for extraction.

To date, Sue has been able to obtain one sample of golden king crab (*Lithodes aequispinus*), two collections of blue king crab (*Paralithodes platypus*), and one sample of the grooved Tanner crab (*Chionoecetes tanneri*).

Peggy Murphy provided a handout titled "Overview of Strategy for Crab Management Modeling" that outlined the overall strategy for studies conducted by Jie Zheng, herself and Gordon Kruse. Jie Zheng provided a handout on the work contained in three manuscripts: "A length-based population model and stock-recruitment relationships for red king crab, *Paralithodes camtschaticus*, in Bristol Bay, Alaska;" "A catch-length analysis for crab populations;" and "Analysis of the current harvest strategy for red king crab, *Paralithodes camtschaticus*, in Bristol Bay, Alaska."

Length-based analyses (LBAs) are methods for linking historical survey data, length-frequency data from onboard observations and dockside samples, and commercial landings statistics. A LBA has been completed for Bristol Bay red king crabs and a paper on the results will be published in the *Canadian Journal of Fisheries and Aquatic Sciences* in 1995. Jie presented results from this analysis including comparison with survey results and stock-recruit relationships. A LBA is nearly completed for Bering Sea Tanner Crabs. Peggy indicated that other stocks planned for LBAs include Adak, Kodiak, and Norton Sound red king crabs, Kodiak Tanner crabs, and St. Matthew and Pribilof Islands blue king crabs.

LBAs provide a framework to investigate crab harvest strategies by computer simulations. Such a simulation study was conducted for Bristol Bay red king crabs. A manuscript is currently in review for the *Canadian Journal of Fisheries and Aquatic Sciences*. Jie presented results that indicated that an optimal harvest strategy includes a 20% mature male harvest rate, 50% maximum cap on legals, and a female threshold of 11.0 thousand tonnes of effective spawning biomass. This strategy is robust to uncertainties with respect to the level of handling mortality and with respect to the relative contributions of long-term oceanographic changes and density-dependent stock effects on recruitment trends. Future simulations on the Bristol Bay stock will examine alternative stock rebuilding strategies and a sensitivity analysis. A simulation of Tanner crab harvest strategies is being conducted.

Jie reported on results of catch-length analyses (CLAs) of Kodiak and Bristol Bay stocks. Unlike LBAs, CLAs require only size frequencies, commercial landings, and fishing effort. Surveys data are not required. Such analyses quantify stock status of unsurveyed crab stocks. In this pioneering effort, Kodiak and Bristol Bay stocks were chosen so that results could be ground-truthed by stock size estimates from assessment surveys. When size frequency data and fishing effort were equally weighted in the model, good fits to surveyed population size were obtained with instantaneous natural mortality set at 0.4. This study found that trends in stock size can be obtained from catch and size frequency data alone. However, to scale these trends to absolute population size, estimates of mortality (or catchability coefficient) are required.

### *ADF&G - Southeast (Douglas and Petersburg)*

Tim Koeneman briefly outlined crab research in the Southeast Region. Most recent work involves the annual crab surveys. Tim referred to the population estimation for Tanner crabs reported by John Clark last year, and Doug Woodby presented his population estimates for red king crabs. Doug used a measurement error model original developed by Jeremy Collie for flatfish on the east coast and subsequently modified by Gordon Kruse and Jeremy Collie for Alaskan red king crab stocks. The model requires survey data on recruits and post-recruits, commercial landings, and an estimate of instantaneous natural mortality. Results indicated that red king crabs in Southeast Alaska are approaching record levels since the inception of the pot survey in the late 1970s.

### *ADF&G - Central (Homer and Cordova)*

As with the Southeast Region, Al Kimker mentioned that most of the investigations conducted by the Central Region involve crab surveys. Al noted his involvement in collecting specimens for crab studies conducted at the Seward Marine Laboratory. Also, Al discussed a ghost fishing study he conducted in which he confined Tanner crabs to pots for 119 d. He monitored mortality and limb loss. A manuscript on the results is currently being reviewed prior to publication in an ADF&G report series.

### *ADF&G - AYK (Nome)*

Charlie Lean described crab data collection in his region. The fishery in Norton Sound for red king crabs has changed dramatically with the creation of a super-exclusive registration area. Whereas observers on large vessels previously collected lots of data, no observers are required on the small boats that participate in the current fishery. Limited data indicate a decline in recruitment in recent years. Also, the previous large boat fishery was conducted in August when the crabs were farthest from shore, but the current small boat fishery is prosecuted close to shore and more females and sublegal males may be handled than previously. Charlie discussed potential studies to better define the inshore-offshore distributions of females and legal and sublegal males.

### *ADF&G - Westward (Kodiak and Dutch Harbor)*

Doug Pengilly gave a brief overview of crab research involvements of the Westward Region. He mentioned the completion of a report by Forrest Blau on an Adak pot survey conducted in 1991. Towards improved population estimation, Doug mentioned the Passive Integrated Transponder (PIT) tag project conducted largely by Leslie Watson and himself, and investigation of kryging methods for survey data by Ivan Vining. Doug briefly described other ongoing studies that were subsequently covered in greater detail by other westward staff and described as follows.



Bill Donaldson presented a very thorough report on a crab classification system. The goal is to distinguish among Tanner, snow, and hybrid crabs by visual computer methods. The problem to be addressed is the retention of misidentified, under-sized Tanner crab in the snow crab fishery. When the snow crab population is large relative to Tanner crabs, modest snow crab harvest rates can contribute to overharvest of misidentified Tanner crabs. This study examined the use of video images that are processed by computer to identify species. Variables included length-width, perimeter area and a "signature" estimated as the change in length of radius from the center of mass for each of 360 1° angle intervals. Best results were obtained by using the signature method. However, results based on the center of a rectangle that encloses the outline of the carapace yielded faster results that were nearly as accurate as the signature method.

Leslie Watson briefly described the Bering Sea tagging program. In September 1994 25,000 red king crabs were caught. Eighty-five percent were males of which there were roughly 15,000 sublegals and 6,000 legals. Eighty-nine percent of male crabs were newshells. Average catch-per-unit-effort was 10 legals per pot. Females were roughly equally divided between mature and immatures.

Leslie reported on a handling study involving 4,200 legal red king crabs in 1993. Tagged crabs were released through a trough while the vessel was at the pot station (control) and other tagged crabs were released dorsal side down over the rail while the vessel was running to the next station (treatment). There was no significant difference in tag return rate of controls (27.1%) and treatment (27.4%).

Donn Tracy described the observer database and its value to LBA and other analyses. The program monitors regulation compliance (size, sex, species), collects measurements of the retained catch, and samples of pot contents for soak time, depth, location, species composition, reproductive condition, and size. A large database has been accumulated since the inception of this program.

Forrest Blau described a project in which young-of-the-year (YOY) red king crabs are collected in artificial substrates. Data collected over 1990-1994 indicate a steady decline of YOY crabs recruited to the benthos. Evidence for density-dependence is being investigated. Forrest also presented plots of daily bottom temperature at 35 feet in Trident Basin, Kodiak. A report on historical ocean temperatures from this location is currently being prepared.

*UAF - Fairbanks, Juneau, Seward*

Al Tyler outlined his work concerning investigations of sources of variation of red king crab year-class strength. The first step was conceptualization involving hypothesis generation, development of functional relationships, and a construction of a logical structure. The second step is computerization although limited data may prohibit this stage, and the third step is validation. The final step is to draw concluding insights about

recruitment processes, state of knowledge, and critical data gaps. Towards this end, Al co-chaired a workshop in May 1994. The meeting included presentation by five speakers and discussions about potential factors in the red king crab recruitment process. A "time/events table" was constructed that included hypotheses about oceanographic and biological events that may affect year class formation for each life history stage. A report on this workshop has been drafted and will be published in the ADF&G report series in the near future.

Shijie Zhou reported on his work with red king crabs. Shijie examined the effects of handling on red king crabs. In summary, no handling effects were found on mortality, bacterial infections, nor righting time. However, crab injury rate was directly related to the number of times that crabs were handled. A manuscript of results has been submitted for journal publication.

Shijie also noted the following observations about mating king crabs: (1) cannibalism occurs frequently during molting of females, (2) large males can protect females before and after molting, (3) the largest male is usually the one to mate, (4) similar-sized males compete which may result in damage to the female, (5) a male of size 77 mm carapace length was the smallest male to mate, (6) one female was successfully mated 13 d after molting, and (7) small males cannot fertilize a full clutch of eggs.

Last, Shijie briefly mentioned his ongoing investigations on the behavior of red king crabs in the vicinity of pots. The objective of this research is, given behavioral observations, to recommend pot design modifications to reduce bycatch of females and sublegal males.

Unfortunately, A.J. Paul was unable to attend the meeting due to other travels. In his stead, Bill Donaldson briefly reviewed AJ's work on shell condition and breeding success in Tanner crabs. When pairs of similar sized oldshell and newshell male crabs were confined with multiparous female mates, the oldshell male dominated during 70% of the matings. In 39% of all copulations, the possession of females was contested. Oldshell males won 69% of those contests. Recently-molted males did not mate with primiparous nor multiparous females.

## **DISCUSSION OF FUTURE PLANS**

During the second day of the meeting, discussions largely focussed on priority research needs in the areas of stock identification, population estimation, stock productivity, and harvest strategies. Plans for stock identifications are delineated in the long-term work plan. In overview, ongoing allozyme analyses for red king, Tanner, snow and hybrid crabs will be brought to conclusion and published. A pilot study of golden king crab allozymes will be conducted to determine whether allozymes can be used to resolve intra-regional stocks. DNA techniques are being explored for their utility to discriminate stocks to finer geographic resolution than possible with allozymes. In the hopes of assessing

long-term genetic selection, baseline levels of genetic variability are being estimated for crab species that are experiencing newly developing fisheries. Last, computer imagery is being investigated for the possibility of identifying stocks based on morphology. As allozyme analyses are finished and pilot DNA and morphology studies completed this year, the future course for studies of crab genetics and other stock identification methodologies will be reevaluated.

Over the short term, three specific recommendations resulted from the meeting discussions on stock identification. First, golden king crab samples are needed to complete the pilot allozyme study. Second, snow crabs in the vicinity of Norton Sound do not seem to reach maturity. Genetic samples may help establish the relationships of these crabs to snow crabs in the remainder of the Bering Sea. Last, Sue distributed lists of red king, Tanner, snow, and hybrid crab collections to assist regional staff in evaluating whether there are any other crab "stocks" that should be added. On all three of these recommendations, Sue will work directly with regional staff as needed.

With respect to population estimation, there was much discussion about potential use of a laser line scanning system (LLSS) for assessments and other benthic studies. The LLSS is mounted in a unit that is towed by a vessel above the sea floor. A blue-green laser light is deflected by a rotating mirror to the bottom. A synchronized detector tracks the single point of illumination thereby minimizing the effect of back-scatter that is problematic to underwater photography systems. The LLSS produces much sharper images than possible with underwater cameras under most turbidity conditions.

Brad Stevens submitted a LLSS funding proposal to the Environmental Protection Agency to study Tanner crab mounds and fish waste disposal sites off Kodiak Island. Other interests among meeting participants include potential use of the LLSS to assess crab abundance, catchability, impacts of trawls and dredges on benthic communities, and lost crab and groundfish pots. In addition to the merits of Chiniak Bay, Kodiak, the group discussed potential benefits of a study in Barlow Cove, Southeast Alaska, where an abundant, closed population of red king crabs reside.

It was agreed that a small group would meet by tele-conference to discuss possibilities for additional proposals for LLSS pilot studies. The group includes Al Kimker, Doug Pengilly, Russ Nelson, Bob Otto, Brad Stevens, Al Tyler and Doug Woodby. A meeting will be organized sometime in January.

There was discussion about a funded CIP for Adak king crab assessments. Approximately \$175,000 was approved by the legislature for expenditure. These funds have not been expended to date in part because the appropriation pays for a relatively short survey of the expansive Adak area. Several options were discussed. These included use of the funds for a survey to be cooperatively funded by industry, technology development (e.g., LLSS), methodology development at a site (e.g., Kodiak) where studies could be conducted more economically, use of funds for analyses of existing data,

and use of funds to pay for a pilot observer program on catcher vessels. Whereas the legislature intended the funds to be used for Adak Island field work, it is possible to seek legislative approval for a related project. Staff from Westward Region and Headquarters will work together on this project in December and January to plan expenditures.

The timing of availability of NMFS trawl survey data was discussed. The issue is that survey catches are analyzed by NMFS-Kodiak staff and gear mensuration data are analyzed by NMFS-Seattle staff. Although raw catch data are available in a timely manner prior to fisheries openings, the adjusted (with mensuration data) catch results sometimes become available very shortly before the earliest fisheries (e.g., St. Matthew and Pribilof Islands king crabs) in the fall. There was an increased awareness of the general timing problem of data availability, and NMFS staff agreed to address this issue to expedite processing of mensuration data in the future.

There was a brief discussion about plans for future population estimation models. Gordon reiterated an overall strategy that involves three approaches. LBAs are applied to stocks when growth and mortality parameters are accessible and when survey, catch, and size frequency data are available. A measurement error model is applied to stocks with slightly less available information: a mortality estimate and survey catches of recruits and post-recruits, and commercial landings. Last, CLAs are useful when surveys are unavailable. Short-term plans for population estimation by ADF&G include Bering Sea and Kodiak Tanner crabs; Adak, Kodiak and Norton Sound red king crabs; and St. Matthew and Pribilof Islands blue king crabs. Sensitivity analyses and comparisons of methods are planned. Near-term NMFS plans focus on Bristol Bay red king crabs: further use of the delta method and development of a stock synthesis model.

Gordon mentioned the ADF&G Computer Services Section has agreed to provide a programmer for the development of a crab fisheries database. Wendy Parker will be available for this project sometime in summer or fall of 1995. The overall goal of the project is to develop a relational database for data from commercial catches, onboard observations, dockside samples, and surveys. This would help ease the burden of data retrieval and would expedite their use in the annual management process, state and federal regulatory arenas, and new research (e.g., LBAs). Peggy Murphy was assigned to be interim chair for an advisory committee. The task of the committee is to develop very specific project objectives and guidelines for this project prior to its initiation.

In the area of stock productivity, there is broad recognition of the long list of needed research including studies of mortality, growth, reproduction, recruitment, habitat, diseases, parasites, and fishing-related effects. Potential federally-funded university projects for next year include radiometric ageing and reproductive dynamics of Bering Sea Tanner and snow crabs (José Orensanz), effects of legal male size on success of red king crab mating (A.J. Paul), king crab pot gear development (Shijie Zhou and Tom Shirley), and Tanner crab recruitment dynamics (Al Tyler).

The group discussed the need for further handling studies. Bob Otto indicated that his laboratory will conduct further experiments with Tanner crabs to examine potential effects of repeated pot retrieval (i.e., "elevator ride study"). Effects of handling on predation mortality was discussed but acknowledged as a difficult phenomenon to study. It was suggested that sonic tags might be a useful tool.

Al Kimker pointed out that current handling practices differ markedly from those typical of historical crab fisheries. Although it was agreed that it is difficult to study effects of historical practices in retrospect, Al pointed out that it is likewise difficult to discount the role of handling in declines of crab stocks that occurred in the past.

It was pointed out that Tanner crabs autotomize their appendages in very cold air temperatures. It may be possible to simulate the effect of cold air temperature on Bering Sea fisheries by linking the published findings of Mark Carls and Chuck O'Clair for red king and Tanner crabs to historical air temperatures for the Bering Sea. Extremely cold periods could be identified and deadloss records could be searched for potential corroboration of results.

Bob Otto mentioned that his laboratory plans further experiments with Tanner crab pots to estimate escape through rings. Bill Donaldson has submitted a proposal for cooperative study with NMFS on mesh size of Tanner crab pots. Al Tyler suggested that Chris Bublitz, who has studied mesh designs for escape of undersized fishes from trawls, might have some contributions to make toward the similar problem in crab pots.

The location of 187 lost crab pots in Chiniak Bay provides the possibility to study ghost fishing very cost-effectively. Proposals have been developed to seek funding to retrieve these pots. Pot retrieval would provide an excellent opportunity to investigate their fishing condition and contents.

The lack of a tag for Tanner and snow crabs that can be retained through the molting process has been problematic for studies of migration, mortality, and growth. Bill Donaldson indicated that he plans to explore an innovative idea for such a tag this year. Pending the outcome of his pilot study, this may be an area for more serious investigation in the near future.

Toward the end of the meeting, there was a stimulating discussion about the difficulties of managing fisheries on stocks for which surveys are very imprecise (e.g., St. Matthew and Pribilof Islands king crabs, Bering Sea hair crabs) and those that lack surveys altogether (e.g., Adak Islands king crabs, grooved Tanner crabs). Due to the fiscal outlook, it was recognized that additional assessment surveys may not be a very practical solution. It was agreed that a more fruitful approach may be to try to develop fisheries-based assessments. New developments, such as CLA, could be coupled to the onboard observer program, to conduct stock assessments. However, estimates of either natural mortality or catchability coefficient are required. Also, there may be a need to reorient

the crab observer program toward pot sampling for sex and size and to de-emphasize enforcement aspects of the program. The issue of placing some observers on catcher vessels was also raised as some fisheries lack sufficient observations due to low numbers of catcher-processors or floating processors.

### **UPCOMING MEETINGS**

Brief mention was made of some upcoming meetings of interest. One is the *North Pacific Symposium on Invertebrate Stock Assessment and Management* during March 6-10, 1995 in Nanaimo, British Columbia. A second is the *International Symposium on Biology and Management of Crabs from High Latitude Habitats* during October 25-27, 1995 in Anchorage, Alaska. Charlie Lean mentioned the possibility of a fisheries symposium in Nome in spring 1995.

It was agreed that these annual interagency crab research meetings are worthwhile. They provide opportunity for state and federal researchers and managers to interact on research of mutual interest. Although December worked well this year's meeting, it was suggested that perhaps the meeting in 1995 could be held in conjunction with the October crab symposium in Anchorage to minimize travel costs.

Participants discussed the need to interact with the crab industry on research. An industry meeting was held in Anchorage in October 1994. Because of many discussions on crab management at the September Council meeting, the October meeting provided opportunity to focus on research. The meeting was very beneficial to agency and industry participants alike. Both research and management components will be included in future annual industry meetings. The next one will occur in the Seattle area in 1995.

### **HANDOUTS**

During the meeting, handouts were distributed by Bob Otto, Lobo Orensanz, Jerry Reeves, Gordon Kruse, Sue Merkouris, Peggy Murphy, and Jie Zheng. Because attenders were able to collect these handouts for themselves at the meeting, these handouts are not attached to this report. However, individuals interested in obtaining copies of any of these handouts can contact Gordon Kruse or the individual authors.

### **ACKNOWLEDGEMENTS**

Steve Davis and his staff are greatly appreciated for graciously hosting the 1994 meeting at the Observer Training Center in Anchorage. The 34 meeting participants are thanked for their active participation that led to a very productive meeting. Peggy Murphy provided helpful comments on an earlier draft of this report.

---

The Alaska Department of Fish and Game administers all programs and activities free from discrimination on the basis of sex, color, race, religion, national origin, age, marital status, pregnancy, parenthood, or disability. For information on alternative formats available for this and other department publications, contact the department ADA Coordinator at (voice) 907-465-4120, or (TDD) 907-465-3646. Any person who believes s/he has been discriminated against should write to: ADF&G, PO Box 25526, Juneau, AK 99802-5526; or O.E.O., U.S Department of the Interior, Washington, DC 20240.

---